Julabo
THE TEMPERATURE CONTROL COMPANY

TECHNICAL REPORT

CREATE IDEAL CONDITIONS AND TEMPERATURES FOR CELL GROWTH WITH BIOREACTORS

Bioreactors can create the ideal conditions for cell multiplication. Like all organisms, cells (bacteria are single-celled organisms without a cell nucleus – there are also anaerobic bacteria) need enough nutrient-rich food and oxygen (not for anaerobic bacteria) and ideal temperatures that are not too hot or too cold. With regard to bioreactors, this means that a specific temperature and gas supply must be ensured and nutrients must be supplied to guarantee constant growth.

Bioreactor

FUNCTION AND DESIGN

A bioreactor performs a variety of functions. However, users need to know the current conditions inside the reactor and how to correct them. To maintain an overview, the data generated during the bioprocess must be mapped, stored, and analyzed in a meaningful way. A bioreactor mainly produces biomolecules. In other words, substances obtained from cells or living organisms: e.g. nucleic acids, lipids, proteins, and carbohydrates. These can be found everywhere in all shapes and structures.
A typical bioreactor should simulate the most natural conditions possible for the cell growth of an organism. The following components are required for the simulation of natural conditions:

- A reactor in which the cells to be cultivated are located and in which all biochemical processes take place.
- A control unit that, for example, controls the gas supply, mixing, and other elements important for the process flow.
- A temperature control system that precisely regulates the temperature, keeps the temperature range constant, and heats or cools as required.
- In addition, there are supporting components such as sensors, probes, hoses, stirrer shafts, etc., which ultimately enable the process.

INTENDED USES OF BIOREACTORS

Bioreactors are available in different sizes and can be used for laboratory or industrial work. They are used to create a wide range of consumer products for use in the medical, pharmaceutical, food, and cosmetics industries. The biomolecules required for this can be developed specifically for each of these industries.

MIXING AND TEMPERATURE DISTRIBUTION

The cell culture inside a bioreactor must always be mixed. If the nutrients are not sufficiently distributed in the bioreactor, the pH value, for example, may change or the cells may not be adequately supplied with nutrients.

The temperature distribution is also important. If the microorganisms or cell cultures are not stirred regularly and evenly, the cultures at the edge of the vessel may heat up too much while the cultures in the center remain too cool. This leads to deviations that can affect the entire process or even bring it to a complete standstill.

The stirring speed to be applied ultimately depends on the organism being cultivated. Plant cells and animal cells react very differently to this stirring speed and the resulting shear stress: in the worst-case scenario, they simply die.

MEASURING AND CONTROLLING TEMPERATURE

Microorganisms and cell cultures work best within certain temperature and pH ranges. If temperatures inside the bioreactor are outside the specified temperature range, the intended bioprocess is slowed down. Specifically adapted temperature control systems prevent damage due to temperature fluctuations. They ensure precise compliance with the specified temperatures by immediately compensating for even the smallest deviations.

Metabolic performance and, ultimately, growth also depend heavily on the enzymes or catalytically active proteins. If inside temperature conditions are problematic or the environmental conditions are generally unfavorable, these cultures may also be destroyed. Mammalian cells in particular require a very specifically restricted temperature range, which must be precisely maintained throughout the entire period.

At the end of cultivation, a predefined temperature change is often required for different cells. This is the case, for example, in the production of penicillin or proteins produced from genetically modified organisms. In others, a so-called temperature shift, i.e. a reduction of the temperature at the end of growth, is required to ensure the stability of the final product.

CONCLUSION

The measurement, regulation, and precise control of temperatures therefore play a crucial role in every phase of cell cultivation. This is the only way to guarantee a high-quality end product or an undistorted research result. Moreover, it is not only necessary to have an even temperature distribution and a constant temperature: depending on which cells are cultivated and which end products are aimed for, specific upward or downward adjustments must be made at the end of the bioprocess to ensure stability and quality.

We support you with the right temperature control systems to ensure successful research and product manufacturing in the food, cosmetics, pharmaceutical, and medical industries. Our adaptable technology and modular accessories can be perfectly tailored to your needs, allowing you to create the ideal environmental and temperature conditions for your cell cultures with your bioreactor.

Do you have any further questions, or do you need a more in-depth personal consultation? Just contact us. Together, we can find the ideal solution for your laboratory or business.